

Partial Translation of Japanese Laid-Open Patent
Publication No. 11-62631
(Published on March 5, 1999)

Japanese Patent Application No. 9-213394
(Filed on August 7, 1997)

Title: APPARATUS FOR CONTROLLING STEP-MOTOR DRIVEN
THROTTLE

Applicant: DENSO CORPORATION

[0010]

Since the above structure does not require a stopper or the like for limiting the rotor position, particularly to the reference position thereof, it is advantageous for the above structure that it is not necessary to take into consideration the design limitation in view of mechanical shocks caused at the time of abutment against the stopper. Further, it is not necessary for the above structure to strengthen the above-mentioned return spring to a level at which the above-mentioned vibration, shock, friction, detent torque, etc. can be absorbed, so as to return the rotor to a predetermined initial position after energization is stopped. Therefore, the return spring can be weakened as long as a backlash of, for example, a reduction gear mechanism can be suppressed. As the return spring is weakened, the generating torque of the motor is reduced, whereby response is improved due to the rotor inertia mass reduction.

[0020]

The lever 6 is fixed to the other end of the throttle shaft 2, and the limit switch (referred to as reference position switch in the present invention) 7 is

attached to the throttle body 1 near the lever 6. The lever 6 turns on the limit switch (full open switch) 7 at the predetermined rotational angler position (reference position) near the valve full open position. The throttle shaft 2 is urged toward the open direction with the return spring 9, in order to prevent the backlash in the reduction gear mechanism 6. The torque of the return spring 9 is set to a range that is larger than the rotational friction torque of the throttle shaft 2 and smaller than the detent torque of the stepping motor 5. As a result, the valve 4 is stopped at an arbitrary position between the full close to the full open when the stepping motor 5 is turned off.

[0026]

In this embodiment, the excitation phase at the above-mentioned full open position (referred to as reference position in the present invention) is detected, that is, the excitation phase where the rotor at the reference position is stabilized is detected. The rotor is returned to the reference position by conducting correction energizations as many times as the step number required for bringing the detected excitation phase to the closest reference excitation phase. Then, the required opening is obtained by conducting energizations as many times as the step number corresponding to the instruction opening inputted after the rotor returns to the reference position.

[0027]

With this mechanism, even if the excitation phase at the predetermined reference position, i.e., the reference excitation phase deviates, it is possible to precisely control the valve to a required opening. In

addition, since this reference excitation phase control only needs a simple sensor or switch which operates at a predetermined angular position, the throttle valve advantageously has a simple structure. The details are further explained referring to the flowchart shown in FIG. 7.